flashing Christmas star

a lively Christmas decoration

The Christmas star described in this article is a far cry from the shoddy and unadventurous gadgets that light and flash around us at Christmas time. A separate control board supplies 128 different patterns for a Christmas star. By arranging the LEDs in different positions on the display board, other eye catchers and ornaments may be created, say, a flashing Easter egg.

Design by H. Kutzer

The star-shaped display board contains 64 LEDs and is driven by a plug-on control board. The latter contains an EPROM type 27C512 as the memory device, offering storage space for more than 8,000 patterns. The EPROM data outputs drive the LED cathodes via ULN2803 buffers. The cathodes may be said to represent the rows of the 8×8 LED matrix shown in **Figure 1**. Column control is assigned to a binary counter (IC3b), which is clocked by an oscillator (IC2d, R1 and C6) at a rate of about 500 Hz. After binary-to-decimal conversion by IC6, a 74LS145, discrete transistor type BC327 act as the eight column drivers. The three least-significant address inputs of the EPROM are driven by the 3-bit binary counter.

A second oscillator (IC2b, C7, R2 + P1) clocks a 13-bit binary counter consisting of two sections of a 4520 and a counter type 4040. The counter outputs are directly connected to EPROM address inputs A3-A15, allowing each program state to be selected sequentially and individually.

In principle, eight of these program states together act as a program which is repeated eight times. Consequently an EPROM with a storage capacity of 64 kBytes may contain 128 programs.

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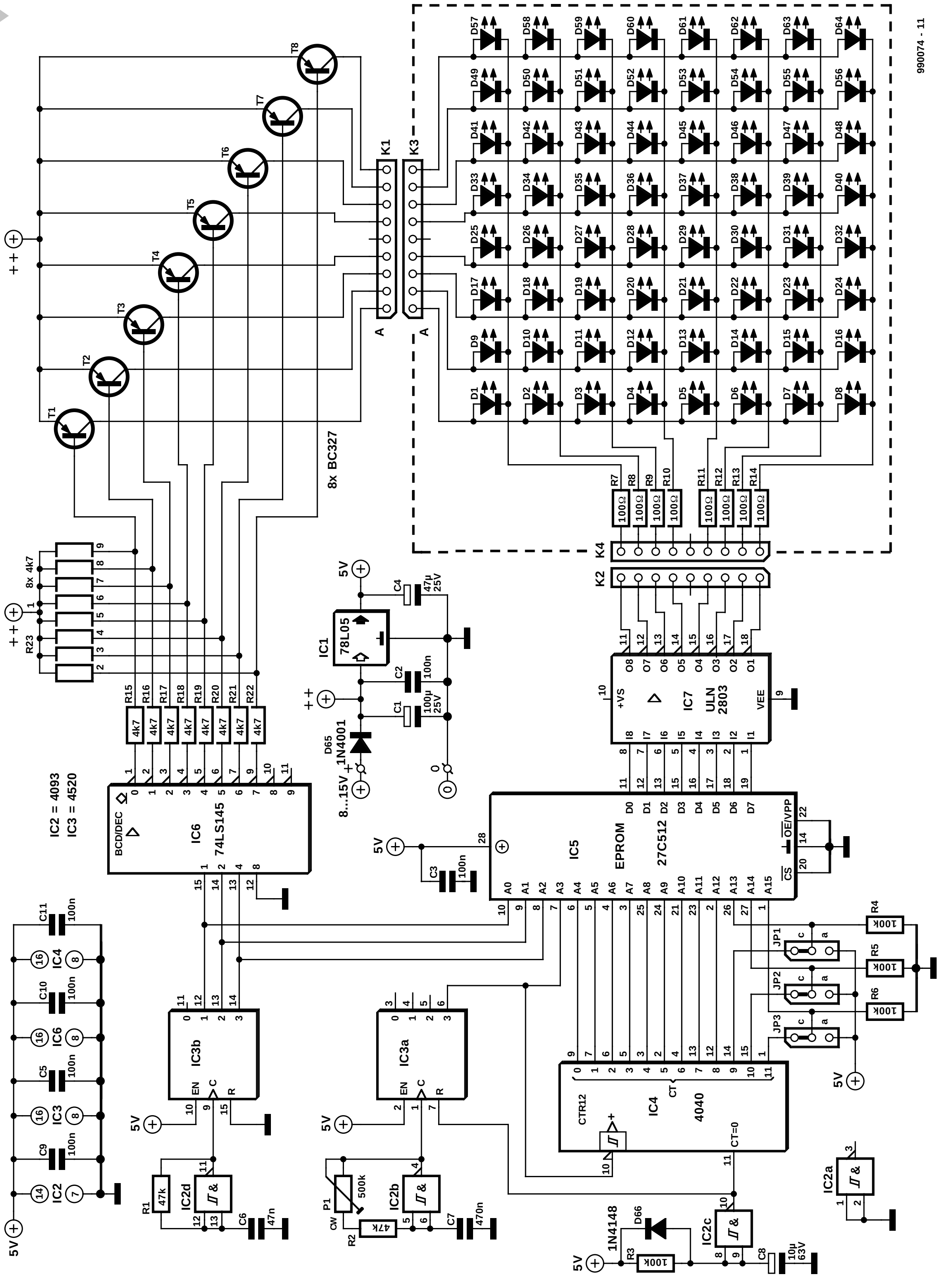

Figure 1. The EPROM contents is 'visualised' in a cyclic manner using an 8˘8 LED matrix.

The EPROM supplied by us under order code **996526-1** contains 32 different programs in the first quarter of its storage space. The second quarter contains the same programs with the LEDs lighting in the opposite direction, that is, the patterns 'move' from the outside to the centre of the star instead of the other way around. The second half of the EPROM is similar to the first, only the programs are inverted.

There is a total of 128 programs available, each with eight repetitions and states. With a whopping 8,192 different states and a clock rate of 0.8 Hz it takes more than two hours before a pattern is repeated.

Together with components R3, D2 and C8, gate IC2c forms a reset generator which clears the address counter to zero when the circuit is switched on.

The flashing Christmas star is powered by a mains adaptor with an output rating of 8-15VDC/1.5 A. A voltage regulator, IC1, is used to turn the unregulated input voltage into one

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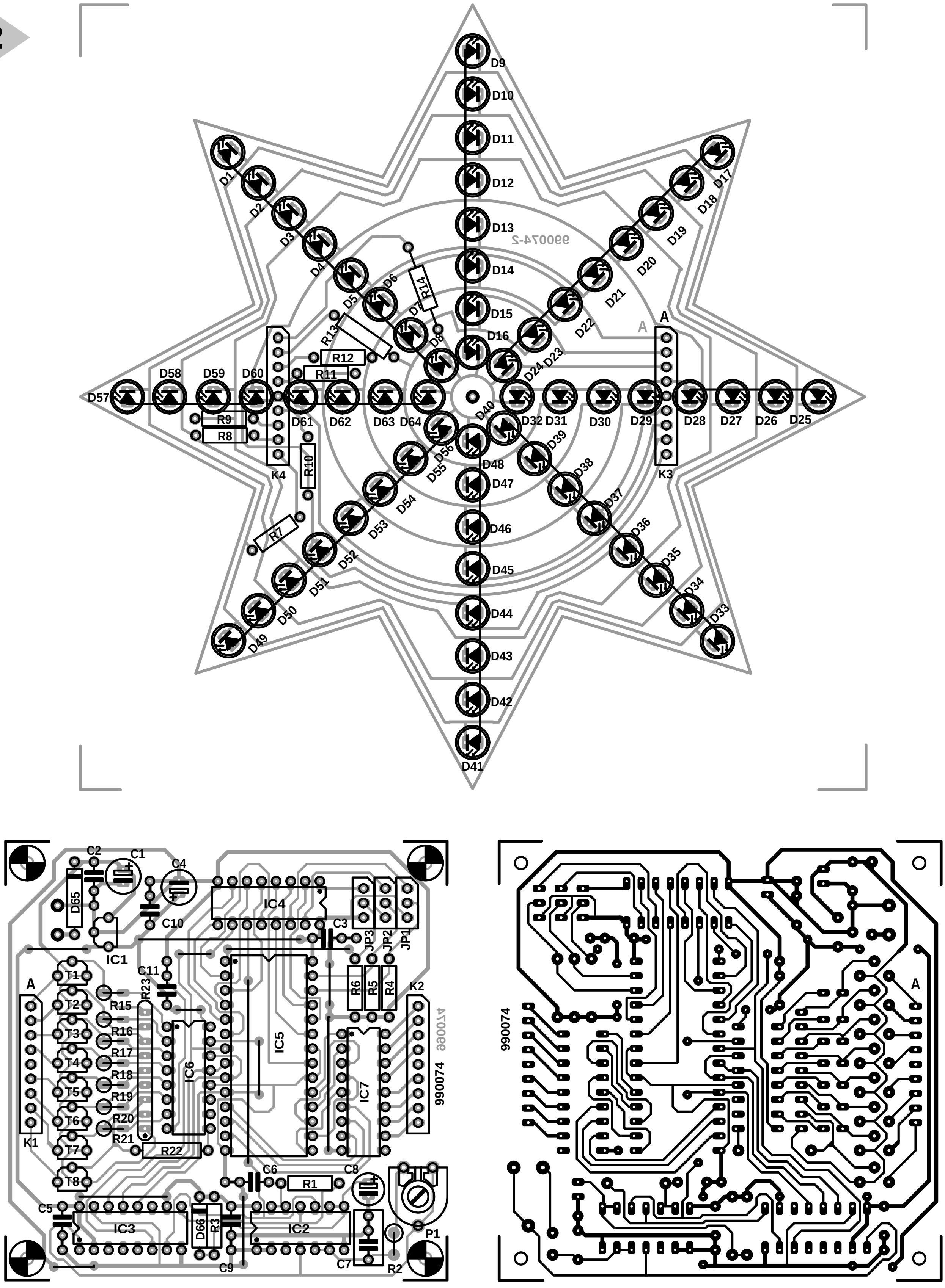


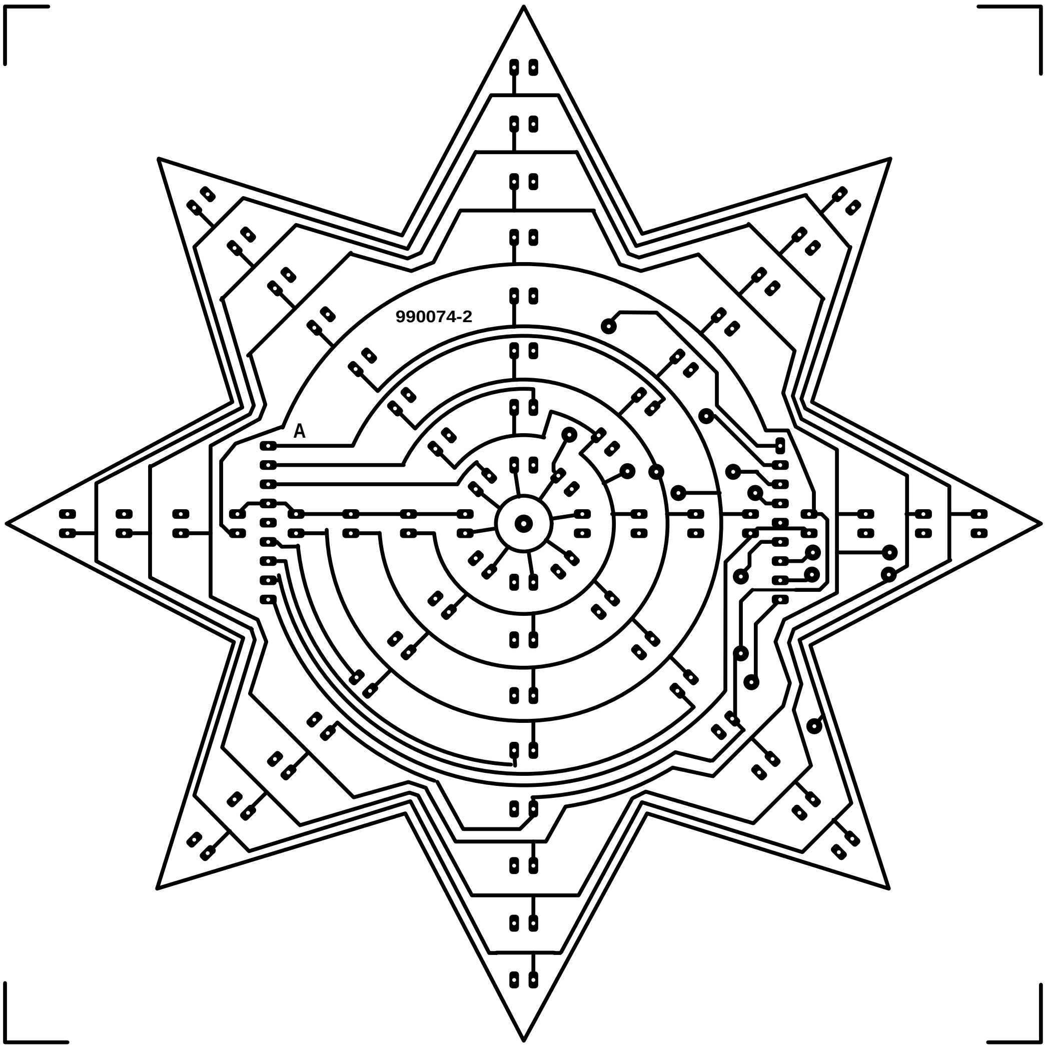
Figure 2. Control board and LED star board. If desired, different patterns may be programmed on the control to create other figures (PCB not available ready-made).

that can be used to power the integrated circuits. Because the LED current does not flow via the regulator, the voltage regulator will not require a heatsink.

The number of different patterns may be expanded almost indefinitely. The largest memory device that can be accommodated is a 512-kByte EPROM with room for 65,536 states.

Jumpers JP1, JP2 and JP3 select the EPROM type used:

EPROM	**JP3**	**JP2**	**JP1**
27C512	c	c	c
27C256	a	c	c
27C128	a	a	c
27C64	a	a	a



COMPONENTS LIST

Resistors:
R1,R2 = 47kΩ
R3-R6 = 100kΩ
R7-R14 = 100Ω (1kΩ when using high-efficiency LEDs)
R15-R22 = 4kΩ7
R23 = 8-way SIL array, 4kΩ7
P1 = 500kΩ preset H

Capacitors:
C1 = 100μF 25V radial
C2,C3,C5,C9,C10,C11 = 100nF
C4 = 47μF 25V radial
C6 = 47nF
C7 = 470nF
C8 = 10μF 63V radial

Semiconductors:
D1-D64 = LED
D65 = 1N4001
D66 = 1N4148
T1-T8 = BC327
IC1 = 78L05
IC2 = 4093
IC3 = 4520
IC4 = 4040
IC5 = 27C512 (order code **996526-1**)
IC6 = 74LS145
IC7 = ULN2803A

Miscellaneous:
JP1,JP2,JP3 = 3-way pinheader with jumper
K1-K4 = 2 off 9-way SIL-connector pair (plug and socket)

When buying the LEDs do not be tempted to buy a ‘bulk pack’, because you risk being landed with different light intensities from individual devices. If you want to employ high-efficiency LEDs, resistors R7-R14 should be increased to 1 kΩ. Connectors K3 and K4 should be mounted at the track side of the star. Construction generally should not present problems, but do observe the polarity of the LEDs (short terminal = cathode). With all parts fitted, carefully inspect the two boards. Next, plug them together, paying good attention to the orientation of the control board, because it is possible to mount it the wrong way around! K1 shold go to K3 (A). With everything secured and in place, apply the supply voltage.

In the first program, individual LEDs are switched on one after another. This test allows you to find and eliminate errors caused by solder bridges, broken tracks or incorrectly mounted LEDs. All LED anodes should be interconnected column-wise. This is best done by leaving the anode wires a bit longer than normal, and then joining them by a ‘common’ rail made from bare wire. This requires 8 extra solder joints. Preset P1, finally, allows the clock rate be adjusted to individual taste.

(990037-1)

Merry Christmas
from all the staff at
Elektor Electronics